624.7
SURVEYS

NOT FOR PUBLICATION
5230(4500)

Furniss
(1) Buckhorn WJT
Bulfam
(4) Carolin YMC
Coulter HKC
Guy
(3) Klein WHK
Mitchell
(2) Orr
Thomas
Wear
Wright

THE STATUS OF DEFOLIATOR INFESTATIONS IN FOREST SERVICE REGION 4

November 1959

By

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INTRODUCTION

Defoliator problems within Forest Service Region Four have been overshadowed somewhat by the occurrence of bark beetle epidemics. Two exceptions were the pine butterfly and spruce budworm infestations in southern Idaho. The pine butterfly epidemic was brought under control by aerial application of DDT in 1954 and from 1955 through 1957 slightly over 2 million acres of budworm infestation were sprayed.

As a result of better surveillance by forest workers and improved aerial detection surveys defoliator infestations are now detected much earlier than in the past. With increased timber management activity in the region has come greater concern over the impact of defoliators on the timber resources of the region.

Entomologists of the Division of Forest Insect Research consider each infestation as it is reported and, when situations warrant it, make followup inspections to collect additional data needed to properly evaluate the biological significance of the outbreak. The evaluations attempt to assess the effect of the infestation on the host, to measure the insect population, and to analyze the biological and physical factors present that could alter the trend of the outbreak. Because damage caused by defoliation has been inadequately studied, interpretations of symptoms and predictions of future defoliation offer some difficulties.

The entomologist evaluates as completely as possible all factors present that could affect the course of an outbreak. This report presents results of evaluations covering all known defoliator infestations within the boundaries of Forest Service Region Four in 1959.

SPRUCE BUDWORM

In southern Idaho from 1952 to 1957 infestations of spruce budworm increased both areawise and in intensity and during this period slightly over 2 million acres of Douglas-fir and true firs were aerially sprayed to control this insect. In 1958 damage levels increased in severity only in limited areas. No control project was recommended in 1958 because most of the budworm infestations then unsprayed were relatively new and tree killing was not expected. Also, it was decided that the significance of existing spider mite infestations in previously sprayed stands should be determined before continuing with the program.

Budworm infestations during 1959 in southern Idaho have mostly decreased in size and intensity or remained static. A few small areas are exceptions and showed an increasing trend, particularly on the Targhee National Forest. Infestations are listed by forest, approximate acreages, and intensity of damage.

Forest	Acreage	Intensity
Payette	5,000	Heavy
Salmon	50,000	Heavy
	115,000	Light-medium
Sawtooth	125,000	Light-medium
Targhee	4,000	Heavy
	200,000	Light-medium
Totals	59,000	Heavy
	440,000	Light-medium
	499,000	Infested

An increase in Rhabdocline pseudotsugae occurred throughout most of the Douglas-fir type in southern Idaho in 1958. In 1959 this disease seemed limited to the Targhee National Forest. Symptoms of the disease complicates aerial detection because of needle discoloration and also makes it difficult to segregate budworm damage on defoliated twigs.

In most cases insect population sampling was carried on throughout the larval and pupal stages, or from early June through pupation late in July and early in August. Where only early larval sampling was done the ultimate defoliation for 1959 was predicted from previously developed correlations based on early larval populations. In all other areas where both larvae and pupae were sampled actual defoliation was recorded. Sequential sampling methods were used in these latter evaluations.

Salmon National Forest

Aerial detection surveys in 1959 revealed a change in the pattern of infestation. For the first time in five years defoliation or infestation occurred in smaller broken areas rather than in large continuous blocks. No new areas were discovered and this pattern is occurring within the older infestations. Within these smaller "centers" practically 100 percent of the trees are infested to some degree.

Ground examination revealed a decrease in intensity of defoliation. In 1958, 100,000 of the 478,000 acres infested on the Salmon showed more than 75 percent defoliation; in 1959 only 10,000 of the 165,000 acres were judged to be that severe.

On the basis of the entire infested area, budworm populations were at a level that caused no serious defoliation, with the exception of the Gibbons Pass area where 75-90 percent defoliation resulted, and to a lesser extent from Dahlonega Creek to Carmen Creek where 50-75 percent defoliation occurred.

During the course of larval development a definite dropping or migration of the mature larvae from overstory to reproduction occurred, resulting in greater defoliation in this age class than in the others.

The season began with an average of 3.34 immature larvae per 15-inch twig and ended with 0.64 mature larvae and pupae. These populations resulted in an average defoliation of 56 percent of the current growth.

A biological evaluation indicates that in 1960 defoliation may be less serious than was experienced in 1959.

Sawtooth National Forest

Infestations on the Sawtooth National Forest have been in progress since about 1949 with rather strong fluctuations in population density from year to year. In 1957 a substantial increase in size occurred followed in 1958 by a definite decrease in damage and population. This decline leveled off in 1959.

The exception to the usual budworm activity in this infestation was the preference for flowering lodgepole pine to Douglas-fir. In general, lodgepole pine suffered from 75-90 percent defoliation and Douglas-fir from 50-75 percent defoliation.

Walt means 65 percent of shoots fed upon. This is equiv. to about 25% defoliation.

Immature larval populations averaged 2.2 larvae per twig and the mature larvae averaged 0.68, resulting in an average of 65 percent defoliation. Biological evaluation indicates a possible increase in 1960. This forecast of an increase in population could very well be subject to error since one-half of the samples were taken from lodgepole pine and a proper weight, due to twig structure differences, has not yet been determined for lodgepole pine. The parasite-predator complex remains at a low level throughout all host stages and no controlling effect is expected.

Targhee National Forest

Infestations of spruce budworm on the Targhee National Forest were first observed in 1956 and were sprayed in 1957. Some reinfestation occurred and some new areas became infested with considerable variation in intensity of defoliation. Only 4,000 of the 204,000 acres currently infested suffered greater than 90 percent defoliation in 1959.

The majority of the affected stands are rated less than average in vigor and occur on poorer than average growing sites. Rhabdocline pseudotsugae is quite prevalent affecting up to 50 percent of the Douglas-fir.

The mature larval population averaged 3 per twig--a decidedly high population at this stage. However, an average of only 0.50 emerged pupal cases per unit resulted which could indicate fewer larvae per twig in 1960.

The ultimate defoliation for 1959 averaged 53 percent but within the Targhee Creek drainage, an area of about 4,000 acres, defoliation was greater than 90 percent.

Only within the Targhee infestation does the parasite-predator complex appear encouraging. On a unit basis, 15-inch twig, these parasites-predators averaged: Agria affinis--2.0; Madremyia--0.3; Glypta--4.0; undetermined Hymenoptera--1.6 and a species of Raphidia--3.0.

Payette National Forest

The Payette National Forest has had considerable infestation during the past few years. This year only 5,000 acres within Profile Creek were infested. Defoliation ranged between 75-90 percent. Severe frost damage to the new growth occurred on the majority of Douglas-fir in this drainage, consequently only alpine fir was defoliated. It is expected that populations in 1960 may be fairly heavy.

Summary

The general budworm picture in southern Idaho in 1959 would seem to be relatively stable at a population-damage level that is less serious than it has been during the past few years. A few exceptions where high populations exist could result in loss of timber if high populations persist, but this is not expected in 1960 due to the general tree vigor and predicted general decline or leveling off of the larval population. In each of the exceptional cases only a minor portion of the total acreage is involved.

Parasites and predators remain at a relatively low level, exerting only limited effects with the exception of a small area of the Targhee infestation where they may be of greater importance in reducing populations.

SAWFLIES

Five sawfly infestations were evaluated in the region: one in lodgepole pine, one in pinyon pine, and three in Douglas-fir. At least three species of sawflies are involved in these infestations. Within the lodgepole pine stands the species is probably Neodiprion burkei (Midd.) and associated on larch in the same location is Pristiphora n. sp. In Douglas-fir stands there is a sawfly that falls in the Neodiprion abietis complex. The sawfly on pinyon pine has not as yet been identified.

Lodgepole pine: The lodgepole-larch infestation was first observed in 1958 when larval populations were quite low. In 1959 these populations, particularly in lodgepole pine, had increased so rapidly that practically all old-growth needles were stripped from the trees on about 5,000 acres of private land around Cascade Reservoir, a fast-growing summer home area.

(cocoons with larvae inside)

Based on pupae per square-foot of duff the lodgepole pine sawfly increased over eight times from 1958 to 1959. Some of the 1959 pupae were reared to adults with only 50 percent emergence resulting. Approximately 12 percent of the larvae failed to pupate due to a virus within the population. Consequently a reduction in numbers is expected in 1960. However, greater than 90 percent of the old-growth needles have been destroyed and while tree growth is expected to be affected no tree mortality is expected.

Douglas-fir: The Douglas-fir infestation was first discovered in 1956 within the Craters of the Moon National Monument. The following year this infestation subsided but low-level infestations were discovered throughout the South Fork of the Boise River and Warm Springs Creek drainages on the Sawtooth National Forest, and within the Douglas-fir stands on private, State, and BLM lands in Owyhee County. These infestations have remained at an endemic level with the exception of approximately 300 acres where heavy defoliation occurred within Deer Creek (BLM) adjacent to drainages on the Sawtooth National Forest.

The Douglas-fir sawfly feeds on new-growth needles within all tree classes. Approximately 75 percent of the stands are infested to some degree. Preference is shown for creek bottom locations in the endemic stages, later spread to the ridges occurs as an epidemic develops. In all cases defoliation varied strongly throughout infested stands. The infested stands range from 4,000 to 6,000 feet elevation, occur on better-than-average sites, and show above normal vigor. This is particularly true of the Owyhee County Douglas-fir which is 60-75 years of age and has averaged 1/16-inch of radial growth every year.

The Douglas-fir sawfly in Owyhee County and the Sawtooth National Forest remained at an endemic level with pupal counts averaging one to two pupae per square foot of duff, and less than 25 percent of the new-growth needles destroyed. The picture differs within Deer Creek where counts averaged 17 pupae per square foot and greater than 90 percent of the new growth was defoliated.

Pinyon pine.--In May 1959 a request for entomological advice was received through a memo received by the Regional Forester reporting defoliation of pinyon pine stands on Bureau of Land Management lands north of Pioche, Nevada. Station entomologists made a biological evaluation and found the defoliation was caused by epidemic populations of a sawfly. The infested area runs from Hulse Canyon on the south to Brown Spring on the north. Approximately 75 square miles of pinyon pine are currently infested. Indications are that the original outbreak started in the vicinity of Hulse Canyon where ninety percent of the pinyon pines are dead; the remaining trees being completely defoliated this year. In the remainder of the infestation defoliation ranges from 10-90 percent in larger trees to 100 percent in the smaller trees. Duff sampling revealed a pupal population averaging 6.14 pupae per square foot. Forced emergence of the pupae is being conducted in the laboratory to determine percent parasitism. To date only 7.2 percent

of the pupae have produced parasites, a figure that may increase when emergence is complete. Even if all the remaining pupae are parasitized it would not indicate a material reduction in the population. Adults from these collections will be prepared and sent to the national museum for identification. Pupal counts are lower than found in many sawfly epidemics. However, we feel that this population is sufficient to result in a continuation of the epidemic unless unusual mortality occurs between now and larval hatch next season.

In the last few years pinyon pine has become an increasingly important Christmas tree species. Defoliation of pinyon pine near Pioche has halted cuttings.

Summary

Of the five outbreaks of sawflies reported it appears that the only infestation on Douglas-fir that is expected to maintain high populations or increase is that on Deer Creek near the Sawtooth National Forest. The infestation on pinyon pine near Pioche, Nevada is also expected to be heavy next season.

PANDORA MOTH

In mid-June of 1959 large greenish-brown larvae were sent to the Division of Forest Insect Research by members of a Station timber forest survey crew. Their verbal report stated that numerous caterpillars were feeding in lodgepole pine stands along the north slopes of the Uinta Mountains on the Ashley National Forest. These caterpillars were identified as larvae of the pandora moth, Coloradia pandora Blake.

An inspection of the area revealed the infestation covered approximately 15,000 acres, extending along both sides of the main road from the Summit Springs Ranger Station through Hickerson Park. The north boundary of the infestation roughly follows the edge of type. The south boundary follows the base of the main ridge of the Uinta range. Biological evaluations of this infestation reveal a heavy population of mature caterpillars. To sample the population, trees 2 to 4 inches d. b. h. were jarred by hitting the bole with large clubs to knock the larvae to the ground. This sampling showed an average of over 50 larvae per tree. One hundred percent of the trees contained some larvae. Trees of large diameter contained many more caterpillars but could not be sampled in this manner. The larvae appeared to feed more or less en masse with large numbers stripping one tree and then migrating to another. It was noted that some caterpillars had the symptoms of a wilt disorder. To obtain some measure of the feeding caused by mature pandora moth larvae a few were reared in the laboratory. These rearings ran for 10 days, showed a mature larvae consumes foliage from a six-inch twig every 24 hours.

To get a better estimate of the damage, and to assess the overwintering population, a second examination was made in early September. About 300 acres were considered to be severely defoliated and about 1 percent of the trees were completely stripped of foliage, with the remainder of the trees defoliated to a lesser degree. The rest of the infestation contains many trees completely defoliated but the over-all defoliation was less severe. Efforts to sample the pupae overwintering in the ground showed the distribution of pupae was not uniform. Only rarely were pupae found beneath the crown of lodgepole pine, instead they were located in the sunny openings within the stand where grass and other low-growing vegetation was present, or wherever the soil and duff had been disturbed such as around uprooted trees, road cuts, and animal burrows. This uneven distribution made sampling difficult. In the sunny openings an average of 3 pupae per spadeful of soil was found. However, samples in the disturbed area ran considerably higher. The loose soil around one badger hole covered about 15 square feet and produced over 600 pupae. Of the pupae collected about 4 percent were putrefied, possibly due to the presence of a pathogen. No evidence of predation by small mammals was noted. Nevertheless, it was concluded that sufficient pupae were present to cause emergence of enough adults to produce epidemic populations. However, in view of the presence of a pathogen, possibly a wilt disease, and the fact that only a limited amount of defoliation will result from the young larvae that will appear late next summer, no control action is being considered for next year. The Division of Forest Insect Research will follow the development of the pandora moth to determine if the epidemic will continue into 1961. If it does there is a possibility that control action will be necessary to save this lodgepole pine stand.

TUSSOCK MOTH

Several outbreaks of tussock moths have occurred during the past 5 years. Probably the most notable was within Owyhee County, Idaho, where 30,000 acres of Douglas-fir were infested with Douglas-fir tussock moth. Other infestations are now active but for the most part are occurring on various species of brush. It is suspected that several species of tussock moth are involved but determinations have not been received from specialists.

Owyhee County, Idaho

This Douglas-fir tussock moth outbreak began in 1956, rose sharply in 1957, and was virtually eliminated in 1958, primarily from action of a virus disease. Only one small drainage remained lightly infested in 1959. The original infestation provided virus for later work on biological control of a tussock moth infesting bitterbrush near Carson City, Nevada.

Carson City, Nevada

This infestation of tussock moth on bitterbrush was first reported in June 1958 and has since been under observation. It also has been the site of experimental tests with a virus. These tests proved that this virus can be

established by applying it at the rate of 10,000,000 polyhedra per acre, and good mortality can be obtained the first year at the rate of 50,000,000 polyhedra per acre when applied in a water suspension with corn syrup as a sticker. In an area separated from the test plots a virus was found occurring naturally within the population which will presumably spread naturally.

The bitterbrush has suffered some twig killing, but during the past two years has managed to put on two crops of leaves annually. No appreciable loss of bitterbrush is expected.

Idaho City, Idaho

Approximately 5,000 to 10,000 acres of ceanothus, willow, bitterbrush, ninebark, ribes, and rose brush were infested with a tussock moth during the summer of 1959. A remarkable event was the occurrence of a virus during this first year that practically eliminated the entire infestation. No egg masses were found during the fall biological evaluations and all brush species, except willow, were refoliating.

Tussock moth mistletoe

A small infestation of tussock moth feeding on dwarfmistletoe on lodgepole pine was found by Dr. Mielke, forest pathologist. This infestation covers about 100 acres and is located near the Buffalo Ranger Station, not far from the Island Park Reservoir on the Targhee National Forest in eastern Idaho. The entomologists examining the situation concurred with Mielke's report that feeding, so far as could be determined, was limited to mistletoe. At the time of the examination in July, larvae were pupating and it could not be determined if larval mortality had been heavier than normal. Unfortunately, it was not possible to re-examine the area after adult emergence and egg laying was completed, therefore we are not in a position to predict the trend of this infestation. However, this is one case where we hope epidemic populations will be present next year. This would enable us to gain more information on this rather unusual situation.

LODGEPOLE NEEDLE MINER

The lodgepole needle miner (Recurvaria milleri Busck.) is an important insect pest of the lodgepole pine forests of the Intermountain Region. The first report of this insect on record for this region concerns an infestation on the Cassia Division of the Minidoka (now Sawtooth) National Forest in 1938 which subsided around 1943. The next report of the needle miner was in 1949 when an infestation developed over most of the lodgepole stands on the Sawtooth, Targhee, and Caribou National Forests. This outbreak died out in 1953.

The present infestations were detected in the fall of 1958, one by aerial survey and the other by one of the Supervisor's staff on the Targhee National Forest. The main infestations are on the Cassia Division of the Sawtooth

National Forest near Warm River and the Big Falls of Henry Fork on the Targhee National Forest. Additional surveys showed a number of smaller infestations on the Bridger, Caribou, and Targhee National Forests.

The lodgepole needle miner has a two-year life cycle, the moths flying in odd-numbered years in this region. This year the insect was in its second year of development. Parasites were found to be causing 7.3 percent mortality in the larvae stage. These parasites have not as yet been identified.

The lodgepole needle miner outbreak has increased in area and intensity now covering about 104,630 acres. Evaluations showed that in all probability this insect activity will continue to increase for the next few years. There is evidence that mountain pine beetle, Dendroctonus monticolae Hopk., may develop epidemic tendencies in areas heavily defoliated by the lodgepole needle miner.[1/] Most of the lodgepole needle miner infestations are in areas with a past history of mountain pine beetle outbreaks.

To date no control methods have been developed to combat large infestations of needle miner.

Summary of lodgepole pine needle miner infestation evaluation showing approximate size and amount of defoliation occurring in 1959

Forest	Area	Acreage infested	Classification of defoliation
Targhee			
	Big Falls-Warm Riv.	17,000	> 20 &< 35 percent
	Robinson-Island Park	56,000	< 15 percent
	Moose Creek	300	< 10 percent
	Warm Creek	700	< 10 percent
	Frazier Riv.	800	< 10 percent
Bridger			
	Call Creek	30	> 75 & < 90 percent
Sawtooth			
	Cassia Div.	28,800	> 10 & < 35 percent
Caribou			
	Eagle Cr.	1,000	< 25 percent
TOTAL		104,630	

1/ STRUBBLE, G. R. Lodgepole needle miner. U.S. Dept. Agr. Forest Pest Leaflet 22 1959.

ASPEN LEAF MINER

The aspen leaf miner (Phyllocnistis populiella Chamb.) has been a serious defoliator of aspen within western Wyoming and southeastern Idaho for the last 10 to 12 years. This infestation covers nearly all of the aspen on the Bridger, Teton, Targhee, Caribou National Forests and Grand Teton National Park. As a result of repeated defoliation by the mining larvae, tree mortality has occurred in patches. The majority of the infested aspen produces only stunted foliage and shows signs that further tree mortality may continue during the succeeding years.

During the one-year life cycle of the miner, the larvae are active from early spring to mid-July. Pupation takes place within the leaf at the end of the larval tunnel. The adults emerge in August and can be found more readily on conifers and grasses which offer protection from winds than on the host tree.

The natural enemies of the aspen leaf miner, parasites, predators, and a possible pathogen have shown no significant controlling influence. There are no known chemical control methods for large infestations.

MEALYBUG

An infestation of mealybug in true firs was reported and evaluated in 1958 north of Hazard Lake on the Payette National Forest. Evidence indicated that a large population had been feeding throughout the growing season. In most cases the affected trees, alpine fir, lodgepole pine, Engelmann spruce, and white bark pine were almost completely covered with deposits of a black sooty mold brought about by the liquid sugary discharge of the mealybugs. Underneath this mold the needles were alive and green, but showed scattered feeding scars. Occasional twig killing was noted, but the damage was light.

In 1959 the Hazard Lake infestation had practically disappeared but some 5 to 10 air miles west around Elk Lake a similar but less intense outbreak was discovered, with approximately 50 percent of the stand infested. Great variation of damage occurs within the infested stands and in a few cases it appears that trees have been affected for the past 2 years. The alpine fir stands, mixed with lodgepole pine, white bark pine, and Engelmann spruce occur above 6,500 feet in elevation and for the most part are on better than average sites for these species. The stands are open, of good vigor, and uneven aged with approximately equal representation of age classes. The entire tree crown is attacked and all tree classes affected. Checks made in July showed adult mealybugs were on about 10 percent of the new-growth needles, whereas in September mealybugs were found only on old-growth needles.

A 2-inch twig sampling unit was utilized and the following table of comparison shows the average per sample unit:

August 1958		July 1959		September 1959	
Number of egg masses	Number eggs per mass	Number adults	Number of egg masses	Number of egg masses	Number eggs per mass
17.5	26.5	7.5	0.35	6.0	26.9

Evidently different generations were sampled in one summer but comparisons between years indicate that the population is less in 1959. The stable number of eggs per mass between years indicates that number of egg masses seems to be the best sample for predicting trend.

SPRUCE MEALYBUG

The spruce mealybug, Puto sp., infesting Engelmann spruce stands in southern Utah is still very active. This infestation covers about 60,000 acres and is located in three widely separated areas: Thousand Lake Mountain, near Loa, Utah, on the Fishlake National Forest; Griffin Springs on the Aquarius Plateau, and Barney Top on the Dixie National Forest, north of Bryce Canyon National Park. The Thousand Lake Mountain infestation was first reported in 1939 and has remained at an epidemic level since. The Griffin Springs and Barney Top infestations were discovered in 1954. The mealybug feeds on both foliage and terminal twigs. Considerable damage, in the form of tree deformity, limb killing, and reduced vigor is present in areas where the pest has been active for several years. In the older infestation on Thousand Lake Mountain some mortality to reproduction is occurring. The evaluations of the current conditions of this infestation indicate that all three areas will have epidemic populations next year.

Stands in the Griffin Springs and north end of Thousand Lake Mountain areas should suffer accelerated damage next year since populations will consist of 2-year-old mealybugs which are known to be the most active feeders. On Barney Top and the south end of Thousand Lake Mountain the mealybug next summer will be mature females producing young and damage is not expected to be too severe. Unfortunately, we cannot predict the life of these epidemics or adequately assess damage in relation to population density. We have no practical methods of controlling a mealybug infestation in high altitude spruce stands.

DISCUSSION

During 1959 Forest Service Region 4 suffered from an increased number of defoliator outbreaks. There was a diversity of species or groups of species including spruce budworm, sawflies, tussock moths, pandora moth, needle miners, leaf miners, and mealybugs.

Evaluating the significance of defoliator outbreaks poses some problems. While it is known that some defoliators are capable of killing trees in a relatively short period of time many species do considerable damage by preventing growth increment but may not cause significant mortality. Incomplete knowledge of biological factors affecting defoliator populations also complicates evaluations. Rather obvious virus disorders are often very effective in reducing outbreaks to a low level in short periods of time. Other factors and methods of measuring their effectiveness are more obscure.

Evaluations of present defoliator outbreaks have been made based on the best information and knowledge available. As a result it appears that no direct control will be needed next summer. There are several small areas of budworm infestation that have been heavily defoliated and may receive considerable feeding next year. Spraying could be justified if partial unit treatment was considered. However, it is felt that little mortality will be suffered if no spraying is carried on in 1960.

If the sawfly epidemic near Pioche, Nevada continues in pinyon pine, treatment might be required in 1961 if Christmas tree values are to be protected in presently uninjured stands.

The pandora moth infestation in 1960 will show little defoliation since larval populations will appear late in the summer and overwinter as small larvae

All known outbreaks will be checked carefully next year to judge validity of the evaluations made this year and forecast future trends.

FOREST SERVICE REGION 4

Key to Defoliator Infestations

	Insect	Host	Approximate size in acres
A	Spruce budworm	D. F., true firs, Eng. sp.	500,000
B	Sawflies	Lodgepole pine	5,000
C		D. F.	300
D		Pinyon pine	50,000
E	Pandora moth	Lodgepole pine	15,000
F	Tussock moth	Bitterbrush	1,000+
G		Ceanothus	10,000
H		Mistletoe	100+
I	Needle miner	Lodgepole pine	105,000
J	Leaf miner	Aspen	500,000
K	Mealybug	Firs - pines - spruce	2,000
L	Mealybug, *Puto* sp.	Eng. spruce	60,000

SOUTHERN IDAHO

BOISE, PAYETTE, SALMON, CHALLIS & TARGHEE NATIONAL FORESTS

SCALE 0 10 20 30 40 MILES

Sawfly

O Host Lodgepole Pine

Δ Host Douglas Fir

OREGON
SNAKE RIVER
EZPERCE N. F.
BITTERROOT N. F.
MONTANA
SALMON RIVER
IDAHO
PAYETTE N. F.
BOISE N. F.
SAWTOOTH N. F.
SALMON RIVER MTS.
CHALLIS N. F.
BEAVERHEAD N. F.
TARGHEE N. F.
SAWTOOTH WILDERNESS AREA
SALMON RIVER MTS. WILDERNESS AREA
Riggins
Burgdorf
Warren
Secesh R.
Salmon R.
Big Creek
Cuprum
New Meadows
Payette Lakes
Mc Call
Yellow Pine
Council
Cascade Res.
Knox
South Fork
Johnson Cr.
Landmark
Middle Fork
Warm Spr. Cr.
Loon Cr.
Cape Horn
Challis
Salmon River
Panther Cr.
Camas Cr.
Lemhi R.
North Fork
Salmon
Leadore
Gilmore
Lima
Monida
Henrys Lake
Ponds
Island Park Res.
Dubois
Camas Cr.
Ashton
St. Anthony
Henrys Fork
Teton River
Mud L.
Kaufman
Birch Cr.
Dickey
Clayton
Stanley
Warm Springs
Lowman
Garden Valley
South Fork
Deadwood Res.
Deadwood R.
Smith Ferry
North Fork
Middle Fork
Weiser
Weiser R.
Crane Cr.
Payette
Payette River
Nyssa
Emmett
Idaho City
North Middle Fork
Atlanta
Obsidian
East Fk.
Big Lost River
Mackay
Howe
Arco
Sun Valley
Ketchum
Hailey
Wood R.
Fairfield
Boise River
Caldwell
BOISE
Nampa
Arrowrock Res.
South Fk.
Anderson Ranch Res.
Union Pacific Railroads
Snake River
Mountain Home
O.S.L.
Idaho Falls

U.S.F.S. OGDEN

SOUTHERN IDAHO

BOISE, PAYETTE, SALMON, CHALLIS & TARGHEE NATIONAL FORESTS

SCALE 0 10 20 30 40 MILES

Spruce Budworm

U.S.F.S. OGDEN

SOUTHERN IDAHO

BOISE, PAYETTE, SALMON, CHALLIS & TARGHEE NATIONAL FORESTS

SCALE 0 10 20 30 40 MILES

Tussock Moth

Host Ceanothus

x Host Mistletoe

OREGON

SNAKE RIVER

NEZPERCE N. F.

BITTERROOT N. F.

MONTANA

IDAHO

PAYETTE N. F.

BOISE N. F.

SALMON RIVER

WILDERNESS AREA

CHALLIS N. F.

BEAVERHEAD N. F.

TARGHEE N. F.

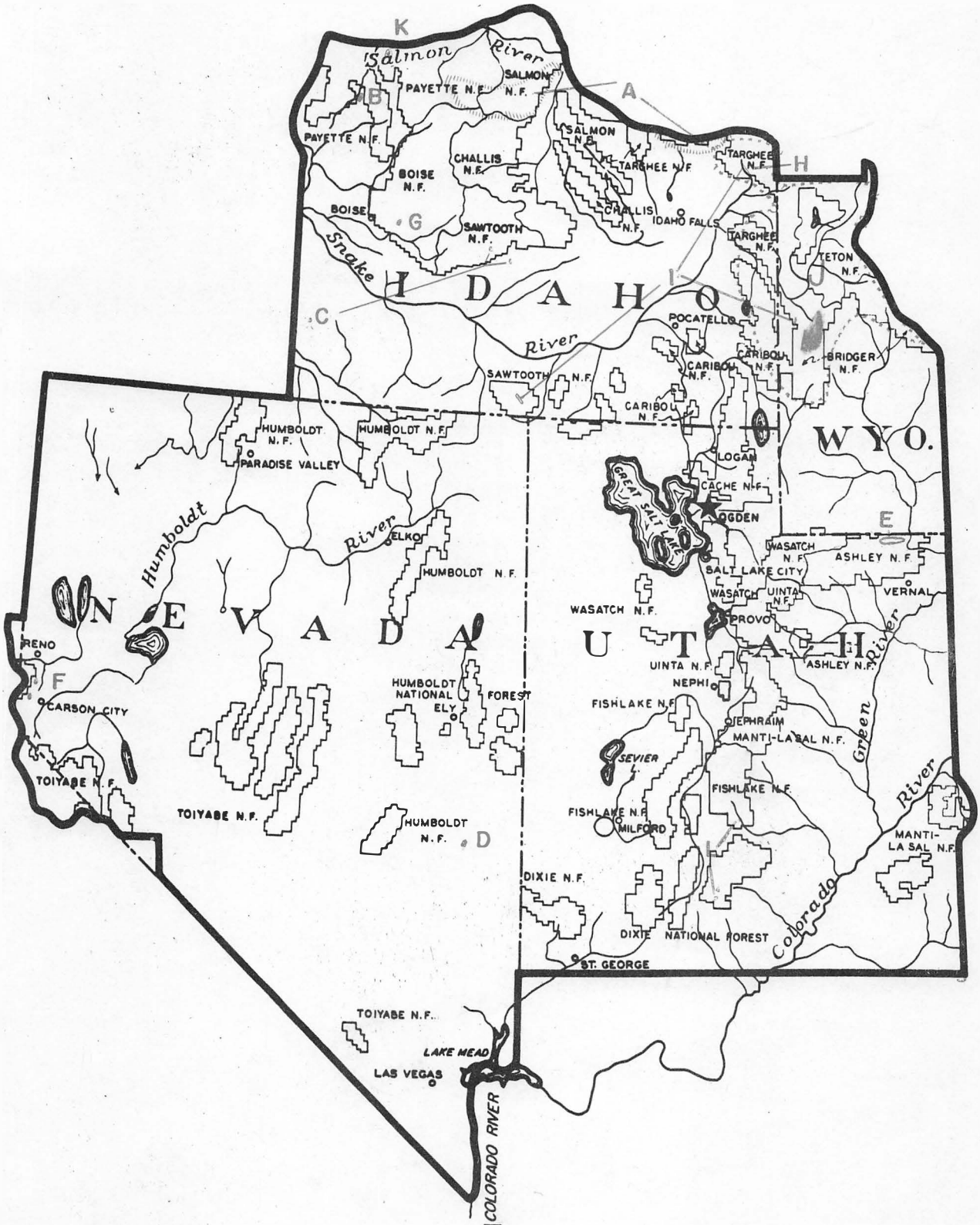
SAWTOOTH N. F.

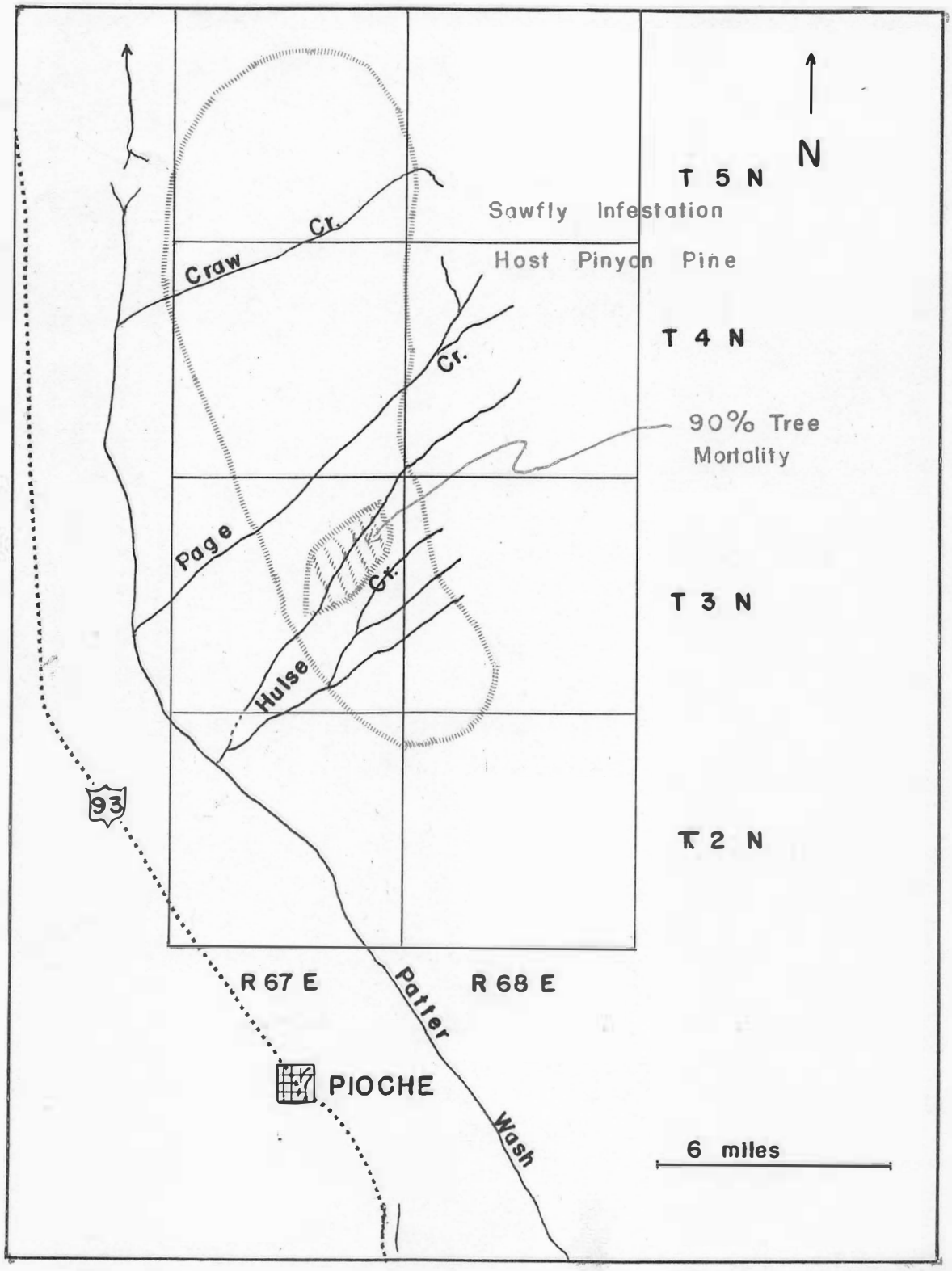
SAWTOOTH WILDERNESS AREA

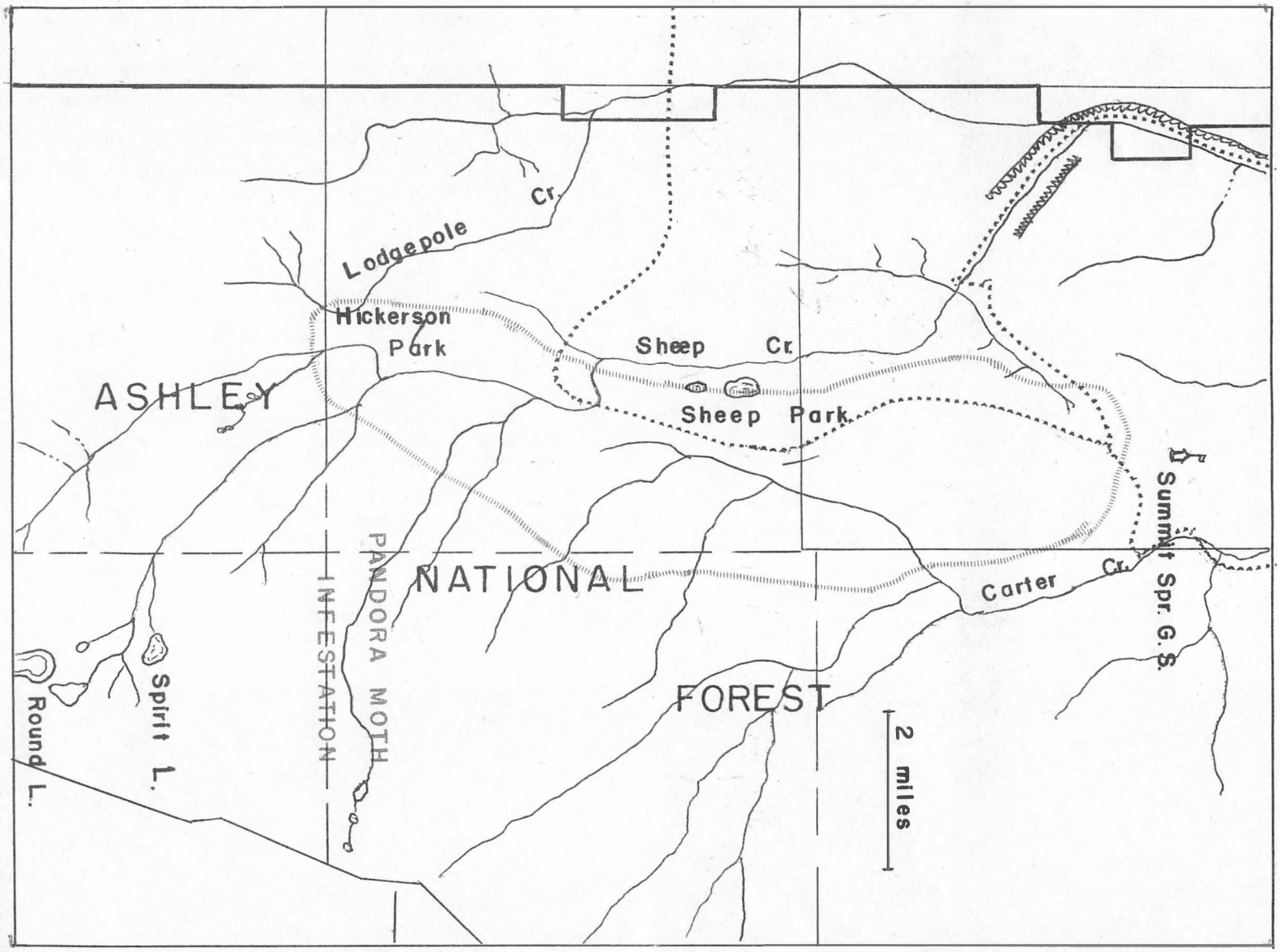
Riggins
Burgdorf
Warren
Secesh R.
Salmon R.
Big Creek
Cuprum
New Meadows
Payette Lakes
Mc Call
Yellow Pine
South Fork
Johnson Cr.
Cascade Res.
Council
Knox
Landmark
Middle Fork
Warm Spr. Cr.
Loon Cr.
Cape Horn
Challis
Salmon R.
Clayton
Stanley
Warm Springs
Deadwood Res.
Deadwood R.
Smith Ferry
North Fork
Middle Fork
Garden Valley
Lowman
South Fork
Dickey
East Fk.
Obsidian
Lost R.
Big Lost River
Mackay
Howe
Arco
Sun Valley
Ketchum
Hailey
Fairfield
Wood R.
Arrowrock Res.
South Fork
Anderson Ranch Res.
Mountain Home
Idaho City
North Middle Fork
Atlanta
Boise River
Nampa
Caldwell
Nyssa
Emmett
Payette River
Weiser River
Crane Cr.
Weiser
Payette
North Fork
Salmon
Lemhi R.
Panther Cr.
Camas Cr.
Leadore
Lima
Monida
Gilmore
Pahsimeroi R.
Kaufman
Birch Cr.
Dubois
Henrys Lake
Island Park Res.
Ponds
Ashton
St. Anthony
Henrys Fork
Teton River
Mud L.
Idaho Falls
Union Pacific Railroad
O.S.L.

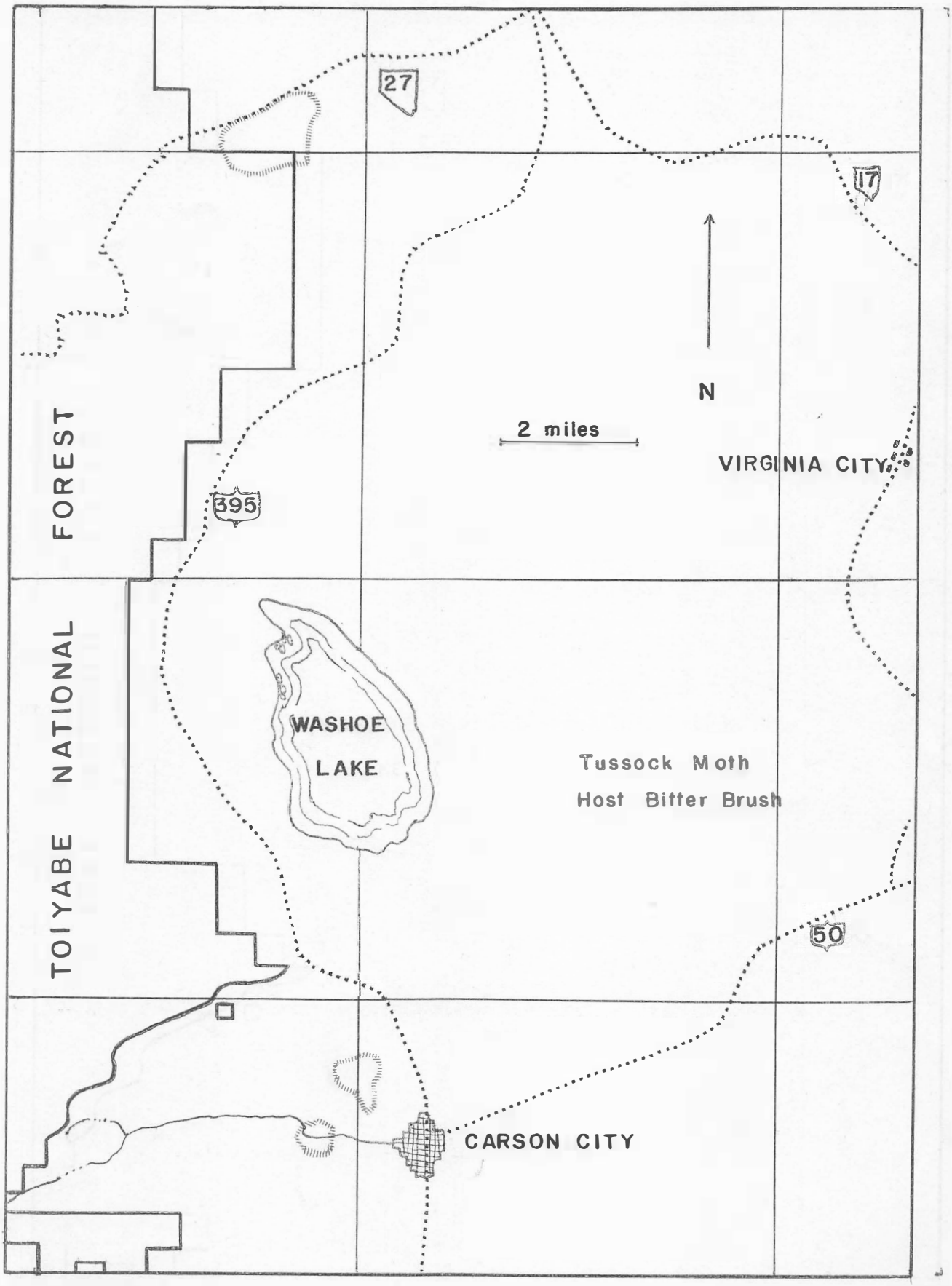
Tussock Moth
Host Ceanothus
x Host Mistletoe

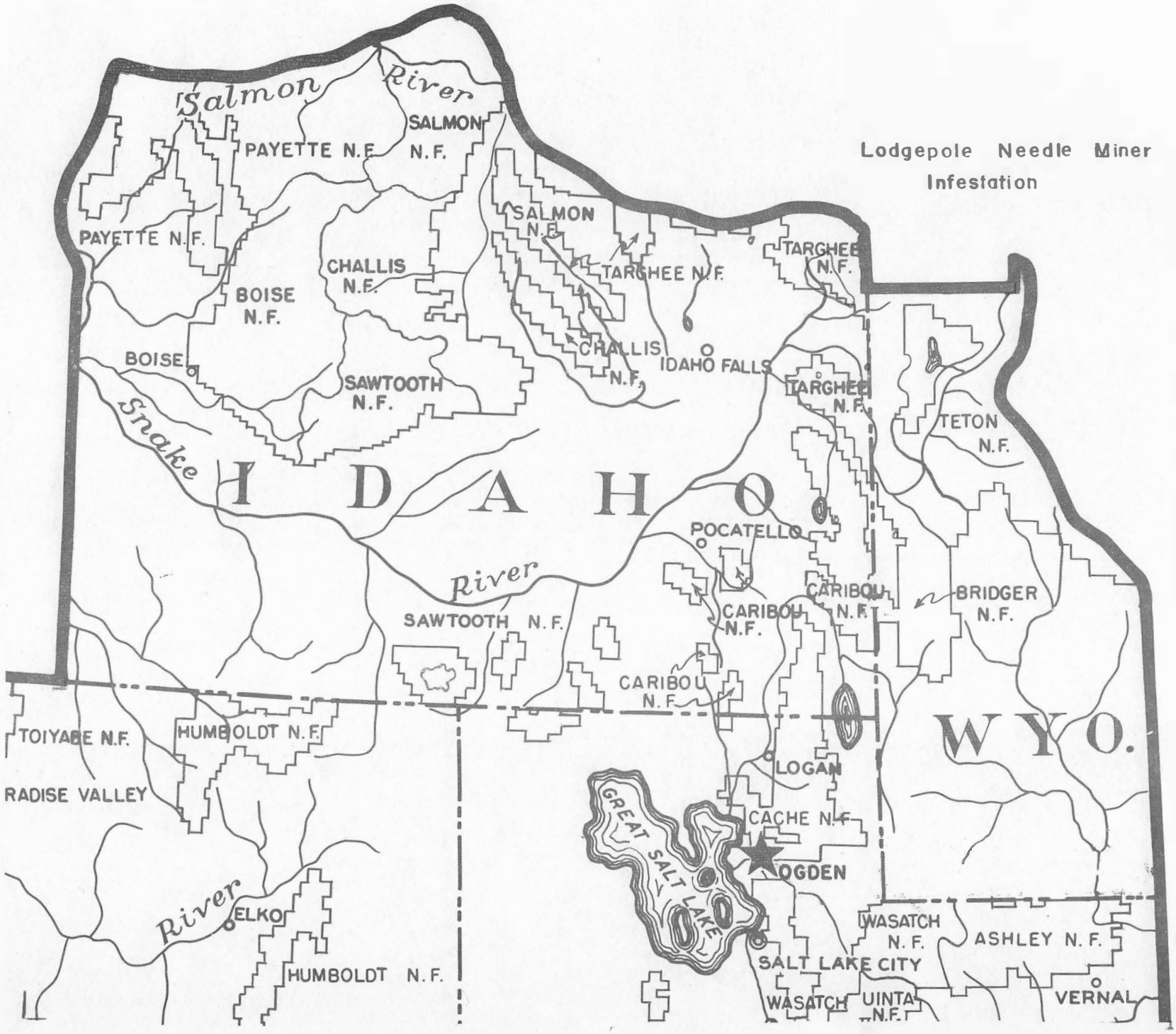
U.S.F.S. OGDEN

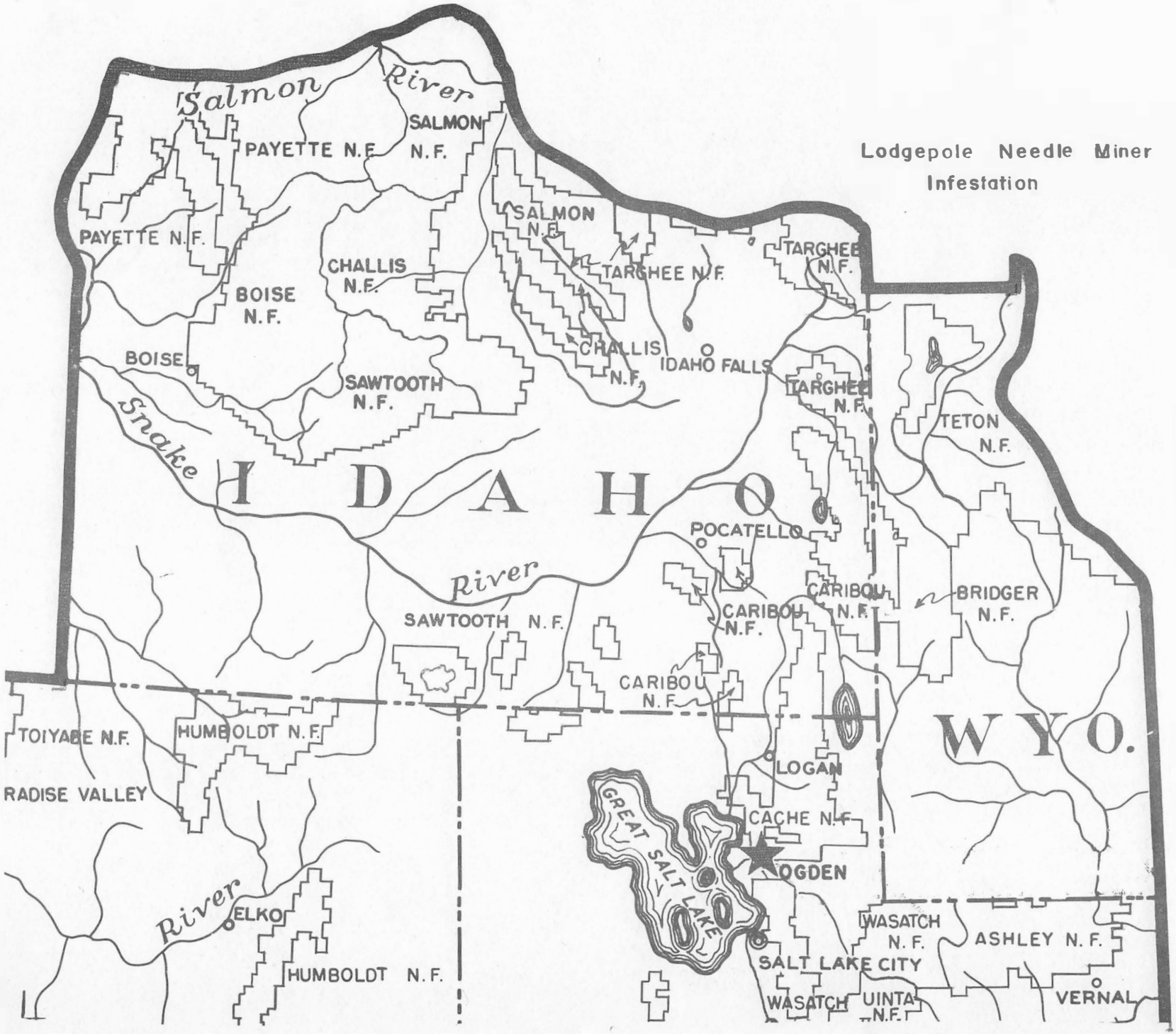

K
Salmon River
SALMON N.F.
A
B
PAYETTE N.F.
PAYETTE N.F.
SALMON N.F.
TARGHEE N.F.
H
CHALLIS N.F.
BOISE N.F.
TARGHEE N.F.
BOISE
G
CHALLIS N.F.
IDAHO FALLS
SAWTOOTH N.F.
TARGHEE N.F.
TETON N.F.
Snake
I
J
I D A H O
C
POCATELLO
River
CARIBOU N.F.
BRIDGER N.F.
SAWTOOTH N.F.
CARIBOU N.F.
CARIBOU N.F.
WYO.
HUMBOLDT N.F.
HUMBOLDT N.F.
PARADISE VALLEY
LOGAN
CACHE N.F.
GREAT SALT LAKE
OGDEN
E
Humboldt
River
ELKO
WASATCH N.F.
ASHLEY N.F.
HUMBOLDT N.F.
SALT LAKE CITY
WASATCH N.F.
UINTA N.F.
VERNAL
N E V A D A
WASATCH N.F.
PROVO
U T A H
RENO
Green River
F
UINTA N.F.
ASHLEY N.F.
HUMBOLDT NATIONAL FOREST
NEPHI
CARSON CITY
ELY
FISHLAKE N.F.
EPHRAIM
MANTI-LA SAL N.F.
SEVIER
TOIYABE N.F.
FISHLAKE N.F.
TOIYABE N.F.
FISHLAKE N.F.
MILFORD
HUMBOLDT N.F.
D
MANTI-LA SAL N.F.
DIXIE N.F.
Colorado River
DIXIE NATIONAL FOREST
ST. GEORGE
TOIYABE N.F.
LAKE MEAD
LAS VEGAS
COLORADO RIVER


N
T 5 N
Sawfly Infestation
Host Pinyon Pine
Craw
Cr.
T 4 N
Cr.
90% Tree
Mortality
Page
Cr.
T 3 N
Hulse
93
T 2 N
R 67 E
R 68 E
Patter
Wash
PIOCHE
6 miles


Lodgepole Cr.
Hickerson Park
Sheep Cr.
Sheep Park
ASHLEY
NATIONAL
FOREST
PANDORA MOTH INFESTATION
Carter Cr.
Summit Spr. G.S.
Spirit L.
Round L.
2 miles


27
17
N
2 miles
VIRGINIA CITY
395
FOREST
NATIONAL
TOIYABE
WASHOE
LAKE
Tussock Moth
Host Bitter Brush
50
CARSON CITY


Lodgepole Needle Miner Infestation
Salmon River
SALMON N.F.
PAYETTE N.F.
PAYETTE N.F.
CHALLIS N.F.
BOISE N.F.
BOISE
SAWTOOTH N.F.
Snake River
SALMON N.F.
TARGHEE N.F.
TARGHEE N.F.
CHALLIS N.F.
IDAHO FALLS
TARGHEE N.F.
TETON N.F.
I D A H O
POCATELLO
SAWTOOTH N.F.
CARIBOU N.F.
CARIBOU N.F.
BRIDGER N.F.
CARIBOU N.F.
TOIYABE N.F.
HUMBOLDT N.F.
RADISE VALLEY
WYO.
LOGAN
GREAT SALT LAKE
CACHE N.F.
OGDEN
River
ELKO
HUMBOLDT N.F.
WASATCH N.F.
ASHLEY N.F.
SALT LAKE CITY
WASATCH
UINTA N.F.
VERNAL


Lodgepole Needle Miner Infestation
Salmon River
SALMON N.F.
PAYETTE N.F.
PAYETTE N.F.
CHALLIS N.F.
BOISE N.F.
BOISE
SAWTOOTH N.F.
SALMON N.F.
TARGHEE N.F.
TARGHEE N.F.
CHALLIS N.F.
IDAHO FALLS
TARGHEE N.F.
TETON N.F.
Snake River
I D A H O
POCATELLO
SAWTOOTH N.F.
CARIBOU N.F.
CARIBOU N.F.
BRIDGER N.F.
CARIBOU N.F.
TOIYABE N.F.
HUMBOLDT N.F.
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W Y O.
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GREAT SALT LAKE
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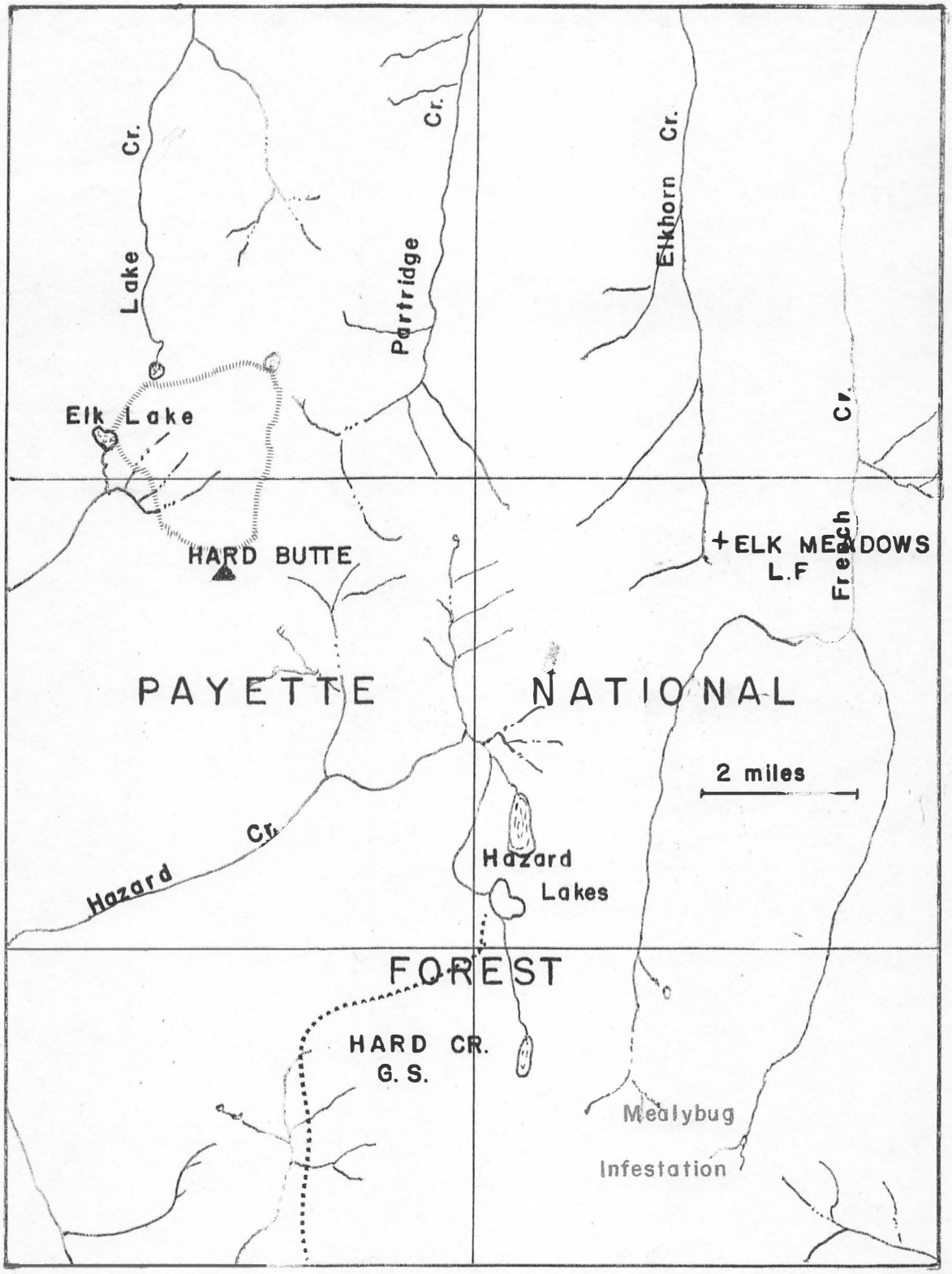
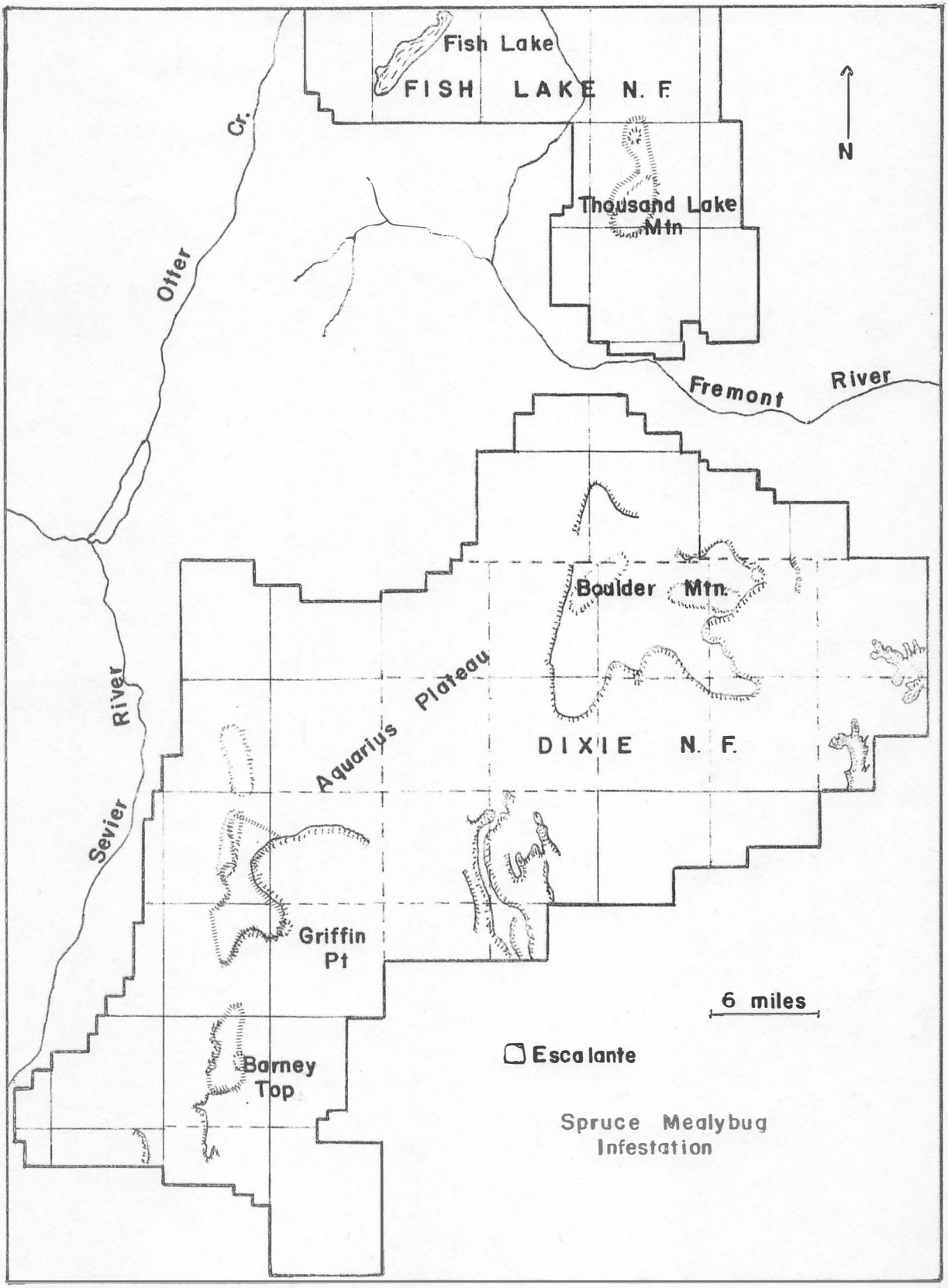
OGDEN
River
ELKO
HUMBOLDT N.F.
WASATCH N.F.
ASHLEY N.F.
SALT LAKE CITY
WASATCH
UINTA N.F.
VERNAL


Lake Cr.
Partridge Cr.
Elkhorn Cr.
Cr.
Elk Lake
HARD BUTTE
+ELK MEADOWS L.F
French
PAYETTE NATIONAL
2 miles
Hazard Cr.
Hazard Lakes
FOREST
HARD CR. G. S.
Mealybug Infestation


Fish Lake
FISH LAKE N. F.
N
Cr.
Otter
Thousand Lake Mtn
Fremont River
Boulder Mtn.
Aquarius Plateau
DIXIE N. F.
Sevier River
Griffin Pt
6 miles
Escalante
Barney Top
Spruce Mealybug Infestation